

These appear to me to be the results of the present investigations: they are still incomplete as to the crystalline forms of dechenite; I would, however, congratulate myself if the hints given in their exposition could provoke further search for distinctly crystallized groups of dechenite.

CONTENTS.

- § 1. Paragenetic relations of eosite.
- § 2. Chemical characters of eosite.
- § 3. Chemical properties of the chromo-wulfenites.
- § 4. Chemical properties of the vanadates of lead (dechenite, descloizite, and vanadite).
- § 5. Crystallographical form of eosite.
- § 6. Crystallographical forms of descloizite and vanadinite.
- § 7. Crystallographical form of the chromo-wulfenites.
- § 8. Discussion of results.

May 11, 1871.

General Sir EDWARD SABINE, K.C.B., President, in the Chair.

The following communications were read :—

- I. “An Experimental Inquiry into the Constitution of Blood and the Nutrition of Muscular Tissue.” By WILLIAM MARCET, M.D., F.R.S., Senior Assistant Physician to the Hospital for Consumption and Diseases of the Chest, Brompton. Received April 1, 1871.

(Abstract.)

The results obtained from the inquiry which forms the subject of the paper are as follows :—

First. That blood is strictly a colloid fluid.

Second. That although blood be strictly a colloid, it contains invariably a small proportion of diffusible constituents amounting to nearly 7·3 grms. in 1000 of blood, and 9·25 grms. in an equal volume of serum, these proportions diffusing out of blood in twenty-four hours.

Third. That the proportion of chlorine contained in blood has a remarkable degree of fixity, a fact which had been foreseen by Liebig, and may be considered as amounting to 3 parts (the correct mean being 3·06) in 1000, the proportion of chlorine in a bulk of serum equal to that occupied by 1000 grms. of blood being 3·45, and therefore higher than in blood, and moreover that one of the objects of the chlorides, and other diffusible constituents of blood, appears to be to preserve the fluid state of the blood. The substances which yield an alkaline reaction to blood are mostly crystalloid; their being retained in the blood while circulating through the body must be of the highest importance in connexion with the phenomena of oxidation constantly in progress during life.

Fourth. That blood contains phosphoric anhydride and iron in a perfect colloid state, or quite undiffusible when submitted to dialysis, the relative proportions appearing to vary from 78·61 per cent. of peroxide of iron and 21·39 of phosphoric anhydride, to 76·2 and 23·8 respectively, the proportion of phosphoric anhydride having a tendency to be rather higher.

Fifth. That blood contains more phosphoric anhydride and potash, bulk for bulk, than serum. This fact has long been known; but I have shown that the excess of phosphoric anhydride and potash in the blood-corpuscles is greater than can be accounted for by the estimation of the proportions of colloid phosphoric anhydride and potash in blood and serum; consequently there exists in blood-corpuscles a power checking the diffusion of the diffusible substances they contain, and apparently connected with a force peculiar to the corpuscles, as this force ceases to act as soon as the corpuscular form disappears from admixture with water. This property inherent to blood-corpuscles may cause an accumulation of potash in blood equal to no less than rather more than four times the amount of this substance present in an equal bulk of the serum of the same blood.

Sixth. That a mixture of colloid phosphoric anhydride and potash can be prepared artificially by the dialysis of a solution of chloride of potassium and phosphate of sodium, and that the colloid mass thus obtained appears to retain the characters of the neutral tribasic phosphate from which it originates; it exhibits an alkaline reaction, yields a yellow precipitate with nitrate of silver, and after complete precipitation the reaction is acid.

Seventh. That by dialyzing certain proportions of phosphate of sodium and chloride of potassium during a certain time, proportions of phosphoric anhydride, potash, chlorine, and soda are obtained in the colloid fluid very similar to the proportions these same substances bear to each other in serum after twenty-four hours dialysis.

Eighth. That muscular tissue is formed of three different classes of substances,—the first including those substances which constitute the tissue proper, or the portion of flesh insoluble in the preparation of the aqueous extract, and consisting of an *albuminous principle* and *phosphoric anhydride* with varying proportions of *potash* and *magnesia*; the second class including the same substances as are found in the tissue proper, and in the same proportions relatively to the albumen present in that class, but existing in solution and in the colloid state; the third class including the same substances as are found in the two others, and moreover a small quantity of chlorine and soda, which, although relatively minute, is never absent. The constituents of this class are crystalloid, and consequently diffusible, the phosphoric anhydride and potash being present precisely in the proportion required to form a neutral tribasic phosphate, or a pyrophosphate, as the formula 2KO PO_5 can equally be 2KO HO PO_5 . The formation of this substance (2KO PO_5) is extremely interesting, and shows beyond a doubt that, in addition to the material blood yields to muscu-

lar tissue for the formation of its insoluble portion, or framework, it supplies flesh with a large proportion of potash, the only object of which is the ultimate removal of the phosphoric anhydride it contains.

Class No. I. of the constituents of muscular tissue is to be considered as the tissue in the complete stage of assimilation.

Class No. II. constitutes the material from the blood on its way to form the Class No. I.

Class No. III. constitutes the material from Class No. I. in the effete state, and on its way out of flesh.

Ninth. That flesh contains in store a supply of nourishment equal to about one-third more than its requirement for immediate use, this being apparently a provision of nature to allow of muscular exercise during prolonged fasting.

Tenth. That the numbers representing the excess of phosphoric anhydride and potash in blood over the proportion of these substances in an equal volume of serum in the regular normal nutrition of herbivorous animals appear to bear to each other nearly the same relation as that which exists between the phosphoric anhydride and potash on their way out of muscular tissue, from which result I conclude that the blood-corpuscles have apparently the power of taking up and preparing the material which they themselves supply to muscular tissue for its nutrition.

Eleventh. That vegetables used as food for man and animals, such as flour, potato, and rice, contain respectively about the same proportions of colloid phosphoric anhydride and colloid potash compared to the total quantities of these substances present; this fact is very remarkable, considering that the proportions of phosphoric anhydride and potash vary to a great extent in these different articles of vegetable food. I also found in some of my analyses of blood that the proportions of colloid phosphoric anhydride and colloid potash to the total quantity of these substances was the same as the corresponding proportion existing between these substances in flour, potato, and rice; and I conclude that vegetable food has the power of transforming phosphoric anhydride and potash from the crystalloid or diffusible into the colloid or undiffusible state, and in certain tolerably definite proportions; and it is only after having been thus prepared that these substances appear to be fit to become normal constituents of blood, and contribute to the nutrition of flesh.

A final remark, and one which is worth consideration, is the fact established by the whole of the present investigation, that there is a constant change, as rotation in nature, from crystalloids to colloids and from colloids to crystalloids. The substances destined to nourish plants being inanimate must be diffusible, otherwise they could not be distributed throughout the mineral kingdom and brought within the reach of plants. Vegetables transform into colloids the mineral substances destined for the food of animals, and it might be said that the locomotion of animals in some respects acts the same part as the diffusion of mineral substances; for animals

move about in search of their colloid food, and crystalloid minerals are displaced by physical diffusion in search of the plants they are to nourish.

The excretory products of animals are crystalloid and diffusible, as far as these soluble constituents are concerned, the solid portions rapidly decomposing in contact with air and moisture into crystalloid compounds. Dead vegetable and animal tissue all return into crystalloids by decomposition, to be distributed afresh, either by gaseous or liquid diffusion, throughout the whole of the mineral world.

Hence Graham's great discovery of the laws of liquid and gaseous diffusion lifts up the curtain which veils the mysteries of animal life, and throws a flood of light on very many physiological phenomena which had until now remained in darkness*.

II. "On Protoplasmic Life." By F. CRACE-CALVERT, F.R.S.

Received May 8, 1871.

A year since, the publication of Dr. Tyndall's interesting paper on the abundance of germ-life in the atmosphere, and the difficulty of destroying this life, as well as other papers published by eminent men of science, suggested the inquiry if the germs existing or produced in a liquid in a state of fermentation or of putrefaction could be conveyed to a liquid susceptible of entering into these states; and although at the present time the results of this inquiry are not sufficiently complete for publication, still I have observed some facts arising out of the subject of protoplasmic life which I wish now to lay before the Royal Society.

Although prepared, by the perusal of the papers of many workers in this field, to experience difficulties in prosecuting the study, I must confess I did not calculate on encountering so many as I met, and especially those arising from the rapid development of germ-life, and of which I have hitherto seen no notice in any papers which have come under my observation. Thus, if the white of a new-laid egg be mixed with water (free from life), and exposed to the atmosphere for only fifteen minutes, in the months of August or September, it will show life in abundance. From this cause I was misled in many of my earlier experiments, not having been sufficiently careful to avoid even momentary exposure of the fluids to the atmosphere. To the want of the knowledge of this fact may be traced the erroneous conclusions arrived at by several gentlemen who had devoted their attention to the subject of spontaneous generation.

I believe that I have overcome the difficulty of the fluids under examination becoming polluted by impregnation by the protoplasmic life existing in the atmosphere, by adopting the following simple method of working.

As a pure fluid free from life, and having no chemical reaction, was essential to carrying out the investigation, I directed my attention to the

* I have had the valuable assistance of Messrs. M. T. Salter, F. A. Manning, and H. Bassett in the analytical part of my inquiry.